

**PROCEDURES AND MINIMUM
REQUIREMENTS FOR STACK TESTS**



**STATE OF NEW HAMPSHIRE
DEPARTMENTAL OF ENVIRONMENTAL SERVICES
AIR RESOURCES DIVISION**

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I. Compliance Test Procedures:

Source testing procedures shall conform to the

requirements of 40 CFR 60.8 and to the most recent revisions of the methods described in 40 CFR Part 60, Appendix A.

A minimum of three consecutive test runs must be conducted for each individual source, or emission point.

Equipment shall be calibrated according to the procedures described in the corresponding EPA Test Method in Appendix A, 40 CFR Part 60 and the calibration results included in each test reported.

A chain of custody procedure must be implemented and a reporting form developed in which each person handling a source test sample is identified.

A stack test report shall be submitted to the Division within 30 days of completion of the test documenting the results of the testing and including all information required by Section V. of this document. The report shall be submitted from the source with a letter signed by the responsible company official signifying that all information contained in the report is accurate and complete.

II. Operating Conditions

In general, compliance tests shall be conducted under one of the following operating conditions:

1. 90 to 100 percent of maximum production rate;
2. Maximum representative conditions; or
3. A production rate at which maximum emissions occur. The specific operating scenario under which a device will be tested shall be determined through discussion and agreement among the facility representative, Division engineer and stack test consultant during the pretest conference (see Paragraph IV below).

If a source chooses to perform tests at a production rate at which less than maximum emissions are expected to occur, a revised operating permit may be issued with an operating restriction reflecting the conditions under which the device was tested.

III. Process Data To Be Recorded

Process data necessary to verify the operating capacity shall be recorded for each test. All process information recorded during normal operations should be recorded during each compliance test run.

The company being tested is responsible for obtaining the process input and/or process rate data. This information should be recorded and an hourly average process rate input determined. The calculations used to determine this average process input rate should be included and described in the test report along with the process data sheets. The process data sheets shall be signed by the responsible company official.

For fuel burning operations, heat input will be determined by measuring the fuel input rate or by the F-factor method using a measured volumetric stackflow. Depending upon the process and fuel type and the decision of the Division, US EPA Method 19 will be used for the F-factors, either by calculation from ultimate analyses of fuel samples taken during the test or by using the published factor.

IV. Notification/Protocols/Observation

At least 30 days prior to the commencement of any testing being performed to show compliance with State Regulations, the Division shall be notified of the planned testing dates so that an observer may be present to approve the testing method. Testing without the presence of a Division observer may require the testing to be repeated.

Also, at least 30 days prior to the commencement of any testing, the source or the testing consultant shall submit to the Division a pretest protocol. This protocol should describe, at a minimum, the test methods to be used, the sampling locations, the process data to be collected, calibration methods and a description of the process being tested.

The source and the consultant contracted to perform the testing shall participate in a pretest conference with a Division representative at least 15 days prior to the

planned testing date.

As specified in PART Env-A 703, sources not subject to the Title V operating permit program, shall be assessed a testing and/or monitoring fee for the time spent witnessing, conducting or evaluating any emissions stack test. The fee will be determined by following the procedures specified in Env-A 703.01(a), (b) and (c).

V. Test Method Requirements:

1. Sampling Time

Minimum sampling time shall be two minutes per point and 60 minutes per test run, with the following exceptions:

- a. For Method 2, time per point shall be long enough to attain steady readings of differential pressure and stack gas temperature;
- b. For Method 4, the sampling time shall be the same as the concurrently run test for which the percent moisture is required, and of a duration long enough to collect the minimum sample gas volume of 21 scf;
- c. For gaseous concentration sampling, shorter sampling time periods may be allowed, if preapproved by the Division, depending on the nature of the test and the variability of the gas concentration measurement.

2. Data Required to be Recorded

- a. For each test series or stack (all Test Methods):
 1. Stack diameter and locations of sampling points;
 2. Distances from sampling ports to nearest upstream and downstream flow disturbances. Include sketch of stack showing these flow disturbances in relation to the sampling location;
 3. Cross-sectional sketch of stack with sampling ports and sampling point locations shown with

dimensions.

b. For US EPA Methods 1 & 2:

1. Barometric pressure, in. Hg;
2. Stack static pressure, +/- in. H₂O;
3. Stack velocity differential pressure, in. H₂O;
4. Stack temperature, degrees R;
5. Pitot tube ID number;
6. Pitot tube coefficient, C_p;
7. Molecular weight of stack gas, assumed or determined;
8. Pitot leak check rate.

c. For US EPA Method 3:

1. Orsat analysis results of integrated flue gas samples;
2. Leak check results.

d. For US EPA Method 4:

1. Barometric pressure, in. Hg;
2. Stack static pressure, +/- in. H₂O;
3. Meter Box ID number;
4. Molecular weight of stack gas, assumed or determined;
5. Start time and end time of run;
6. Dry gas meter calibration factor, Y;
7. For each sampling point, the sampling point location, sampling time per point, stack gas temperature, initial and final dry gas meter volume reading to nearest 0.01 ft³, and dry gas meter inlet and outlet temperatures;
8. Sampling pump vacuum pressure;
9. Pre- and post-test weights or volumes of each impinger;
10. Post-test leak check rate and vacuum.

e. For US EPA Method 5:

All of the data recorded for Methods 2 and 4, plus the following:

1. For each sampling point, the orifice meter differential pressure ($_H$), the stack gas velocity differential pressure, the sampling pump vacuum pressure, the filter box temperature, and the temperature of the sample gas leaving the last impinger,;
2. Sampling probe nozzle diameter;
3. Filter ID number;
4. Nomograph correction or K factor;
5. Orifice constant, $_H@$;
6. Post-test sampling train leak check rate and vacuum pressure.

Lab data for each Method 5 test:

1. Pre- and post-test filter weight(s);
2. Probe and cyclone wash results;
3. Results from acetone blank (one for each series)

All lab data will be included in the test report - number, tare, final, net (recorded to the nearest 0.1 mg). Milliliters of acetone used in blank and each wash will be recorded.

- f. For Gas Concentrations, US EPA Methods 3A, 6C, 7E, 10:
 1. Analyzer instrument range;
 2. Calibration gas cylinder numbers, gas concentrations, and cylinder expiration dates (the certification sheet for any calibration gas used during the test shall be included in the test report);
 3. Pre-test analyzer and measurement system responses to zero and span calibration gases;
 4. Pre- and post-run measurement system calibration responses to zero and span calibration gases;
 5. Start time and end time of each run;
 6. Concentration of the stack gas averaged over run duration, and uncorrected for any calibration drift or to any particular percent moisture or diluent gas.

- g. Other US EPA Test Methods - 16, 18, 23, 24, 25
25A, 26, 29, 202A etc.:

All information as would be required by a similar method mentioned above, as well as any additional data required to be recorded by the test method as specified in 40 CFR 60, Appendix A.

4. Calculations Required

The following information shall be calculated for each test:

Note: Standard conditions are 68°F and 29.92 in. Hg.

- a. For US EPA Methods 1 & 2:

1. Absolute stack pressure, in. Hg;
2. Average stack velocity differential pressure, in. H₂O;
3. Average of the square roots of stack velocity differential pressure, $\sqrt{[\text{in. H}_2\text{O}]}$;
4. Average stack temperature, degrees R;
5. Average stack gas velocity, fps or fpm;
6. Stack gas volumetric flow rate, acfm and scfm.

- b. For US EPA Method 3:

1. Percent O₂ and CO₂.

- c. For US EPA Method 4:

All of the information calculated for Method 2, plus the following:

1. Weight or volume of water collected, g or ml;
2. Volume of water collected as a gas corrected to standard conditions, scf;

3. Gas volume measured by dry gas meter, dcf;
4. Gas volume at standard conditions, dscf;
5. Absolute average dry gas meter temperature, degrees R;
6. Moisture content of stack gas, %.

d. For US EPA Method 5:

All of the data recorded for Method 4, plus the following:

1. Total weight of particulate collected, mg;
2. Cross-sectional area of nozzle;
3. Average orifice meter differential pressure, in H₂O;
4. Molecular weight of stack gas;
5. Concentration of particulate matter in stack gas, g/dscf;
6. Emissions of particulate matter in units of the applicable standard;
7. Percent isokinetic for each test. This value should be between 90-110% for the test to be valid, unless special approval is given by the Division following EPA guidelines.

Note: For calculations of particulate emissions in units of lb/MMBtu of heat input from a coal or wood-fired device, the emission rate may be corrected for unburned carbon in the ash (i.e. loss on ignition, or LOI), partial combustion of the fuel to carbon monoxide and, if one is in use, absorption of CO₂ in a wet scrubber. These corrections can be found in the EPA-published Air Pollution Training Institute manual for Course 474, Continuous Emissions Monitoring Systems, Appendix B-12 or by contacting the Division.

e. For Gas Concentrations, US EPA Methods 3A, 6C, 7E, 10:

1. Analyzer calibration error;
2. Sampling system bias;

3. Zero drift for each run;
4. Calibration drift for each run;
5. Start time and end time of each run;
6. Concentration of the stack gas averaged over run duration, and corrected for any calibration drift or to a particular percent moisture or diluent gas, as required;
7. Emissions from stack in units of the applicable standard.

- f. Other US EPA Test Methods - 16, 18, 23, 24, 25 25A, 26, 29, 202A etc.:

All calculations as would be required by a similar method mentioned above, as well as any additional information required to be calculated by the test method as specified in 40 CFR 60, Appendix A.

*All calculations shall be explained in detail (include sample equations and methods, etc.).

5. Other Considerations

a. Cyclonic Flow:

Prior to taking any stack gas velocity or volumetric flow rate measurements, the absence of cyclonic and/or non-parallel flow must be verified for each source, according to the procedures outlined in 40 CFR, Part 60, Appendix A, Method 1, Section 2.4.

b. Stratified Flow:

Prior to measuring gaseous pollutant concentrations, the absence of gas concentration stratification must be verified by measurement of a pollutant concentration at locations across the stack diameter, typically at locations equal to or equivalent to those chosen for a US EPA Method 2 velocity traverse.

Note: Historical data or observer discretion may be sufficient in determining the absence of cyclonic and non-parallel flow or stratified flow.

6. Equipment Calibration

a. Pitot Leak Checks:

At the start and conclusion of a test series, at a minimum, each side of the pitot tube and connecting tubing must be leak checked from the pitot face opening through the inclined manometer or magnehelic according to 40 CFR, Part 60, Appendix A, Method 2, Section 3.1. The Division highly recommends periodic leak checks over a series of runs to prevent having to void any more test runs than necessary as the result of an unsatisfactory leak check.

b. Thermometers/Thermocouples:

All thermometers and thermocouples must be calibrated annually against a precision mercury in glass thermometer at a minimum of 3 different temperatures over the suspected range of use. Before each test series, compare the ambient temperatures as indicated by the above thermometer to a precision mercury in a glass thermometer and record these readings on the data sheets.

All temperatures during annual calibrations and pre-test checks must be within 1.5% of the precision thermometer or the temperature readings may be rejected.

c. Pitot Tubes:

Pitot tubes must meet the design criteria as described in method 2 of 40 CFR, Part 60, Appendix A or calibrated in an approved wind tunnel according to the directions in sections 4.1.2 - 4.1.3 of the above method.

If the design criteria method of calibration is used, the alignment specifications must be reaffirmed whenever the tubes become visibly misaligned or every 3 months, whichever is sooner.

If the pitot tubes are to be calibrated in a wind tunnel, they must be calibrated whenever they become visibly misaligned or semiannually, whichever is sooner.

d. Nozzles:

The openings of probe nozzles must be concentric and free from distortion. Before each use, they must be calibrated by measuring the ID, to the nearest .001 of an inch, at 3 different diameters.

The nozzle is unacceptable for use if the difference between the high and low value is greater than .004 inches.

e. Orsat validation:

Before each test series, the Orsat analyzer must be leak checked according to 40 CFR, Part 60, Appendix A, Method 3, Section 5. If integrated Orsats are required, a leak check of the flexible bag as described in section 4.2.2 of the above method is required.

Before each test series, an ambient air sample must be introduced into the analyzer and the percent oxygen determined. This reading must be 20.9 ± 0.1 percent or corrections to the Orsat readings must be made.

f. Dry Gas Meters:

Dry gas meters must undergo an initial complete calibration against a wet test meter or other approved standard calibrating device prior to use

in the field following the method specified in 40 CFR, Part 60, Appendix A, Method 5, Section 5.3.

After each test series, the dry gas meter must undergo a post-test calibration check consisting of 3 repetitions at a single intermediate orifice setting determined from field test data. These checks may be conducted through a wet test meter or approved calibrated dry gas meter. The average post-test check value should not deviate by more than 5% from the latest pre-test calibration factor.

If the deviation is greater than 5%, the dry gas meter must undergo a complete calibration and the meter correction factor yielding the lowest gas volume will be used to calculate emission rates.

Note: Wet test meter capacity and liquid level adjustment are critical factors in assuring the accuracy of results.

An alternative post-test calibration check procedure using a calibrated critical orifice designed to be inserted at the inlet of the sampling meter box may be used provided that:

1. The critical orifice and post-test calibration procedure is approved by this agency prior to use.
2. The critical orifice is calibrated annually simultaneously with the meter box and corresponding meter correction factors obtained.
3. The critical orifice used in post-test calibration checks must be near the average of the flow rates encountered during the field tests.
4. The post-test meter correction factors must be within 5% of the initial meter calibration factors.

g. Method 5 Analytical Procedure:

All particulate samples (tares, finals, etc.) must be desiccated at least 24 hours before weighing. After initial weighing, samples must be returned to the desiccator for at least 6 hours and then reweighed. The two weights should agree within ± 0.5 mg, if not, desiccate for another 6 hours and reweigh. If a constant weight (± 0.5 mg) cannot be obtained within 3 repetitions, consult this agency for advice.

Split, duplicate, etc., samples may be requested at any time by this agency to assure laboratory quality assurance.

Note: During sample clean-ups brushes should be sized so that they fit snugly each piece of sample equipment required to be cleaned.

The analytical balance used for weighing particulate samples must be capable of measuring to the nearest 0.1 mg. This balance must be checked before each use with NBS traceable class 5 weights within the range of use. The balance must be adjusted to read within ± 1 mg of the class 5 weights or repaired.

VI. Alternative Methods

Any deviation from these procedures and requirements must be thoroughly explained and approved by the Division prior to testing.

VII. Test Acceptance:

Failure to observe any of these procedures and requirements may be grounds for denying the acceptance of the test and/or results.

Any questions concerning these procedures and minimum requirements shall be directed to the New Hampshire Air Resources Division, Compliance Bureau, at (603) 271-1370.

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